DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,
LONERE – RAIGAD -402 103
Mid Semester Examination – October - 2017

Branch:M.Tech (Wireless Communication and Computing) **Sem.:- I**

Subject with Subject Code:- Wireless Communication Network; MTWCC102 **Marks: 20**

Date:- **Time:- 1Hr**

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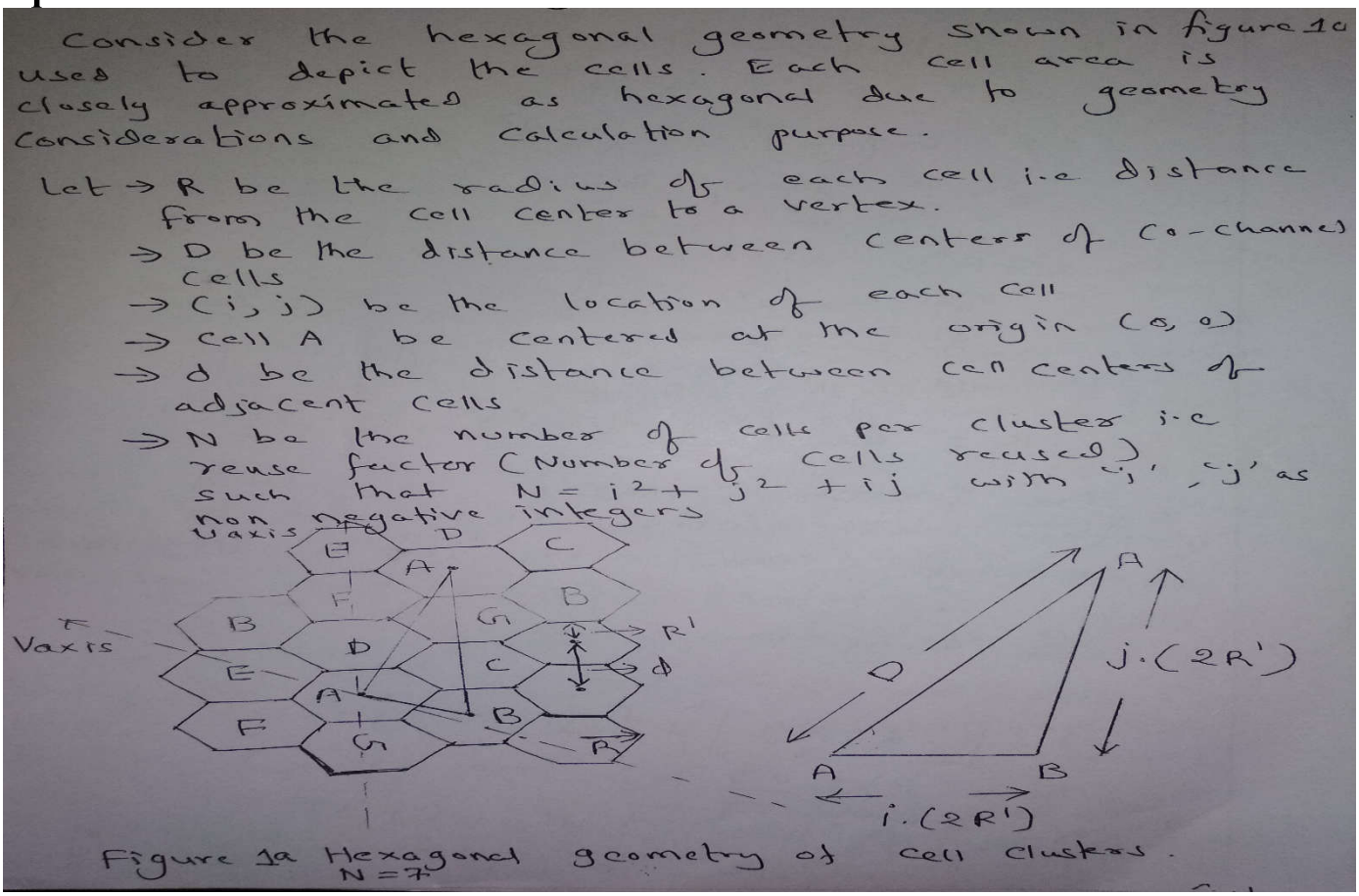
MODEL ANSWERS **(Marks)**

Q.No.1a.) Prove that for a hexagonal geometry, the co-channel reuse ratio is given by , where $N = i^2 + j^2 + ij$, and i, j are non-negative integers. **(08)**

Solution) 4 marks for figure and initial derivation and half mark for each equation numbered from 1 to 8.



From figure 1b

$$C'I' = \frac{R}{2} \; ; \; O'I' = \frac{d}{2} \; ; \; O'C' = R$$

$\therefore$ By Pythagoras theorem

$$O'C'^2 = O'I'^2 + C'I'^2$$

$$R^2 = \left(\frac{d}{2}\right)^2 + \left(\frac{R}{2}\right)^2$$

$$R^2 = \frac{d^2}{4} + \frac{R^2}{4}$$

$$4R^2 = d^2 + R^2$$

$$d^2 = 4R^2 - R^2$$

$$d^2 = 3R^2$$

$$d = \sqrt{3}\,R \qquad -(1)$$

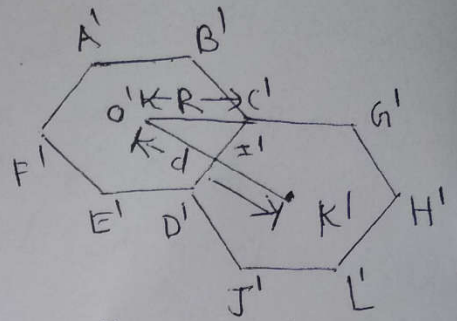


Figure 1b

$$\therefore R' = O'I = \frac{d}{2} = \frac{\sqrt{3}}{2} R \qquad -(2)$$

The location relative to cell A which is centered at the origin (0, 0) can be obtained by moving i cells along the u axis, then turning 60 degrees counterclockwise and moving j cells along the v axis.

Using the cosine law we have

$$D^2 = \left[i \cdot (2R')\right]^2 + \left[j \cdot (2R')\right]^2 - 2i \cdot (2R') \cdot j \cdot (2R') \cdot \cos 120^\circ \qquad -(3)$$

where $R' = \frac{\sqrt{3}}{2} R$ from eq. (2)

$$\therefore D = \sqrt{3i^2R^2 + 3j^2 \cdot R^2 + i \cdot j \cdot 3R^2} \qquad -(4)$$

$$D = \sqrt{3R^2(i^2 + j^2 + ij)} \qquad -(5)$$

$$D = \sqrt{3}\, R \sqrt{(i^2 + j^2 + ij)} \quad -(6)$$

$$D = \sqrt{3} R \sqrt{N} \quad -(7)$$

$$D = R \sqrt{3N} \quad -(8)$$

Hence

The co-channel reuse ratio α is

$$\alpha = \frac{D}{R} = \sqrt{3N} \quad -(9)$$

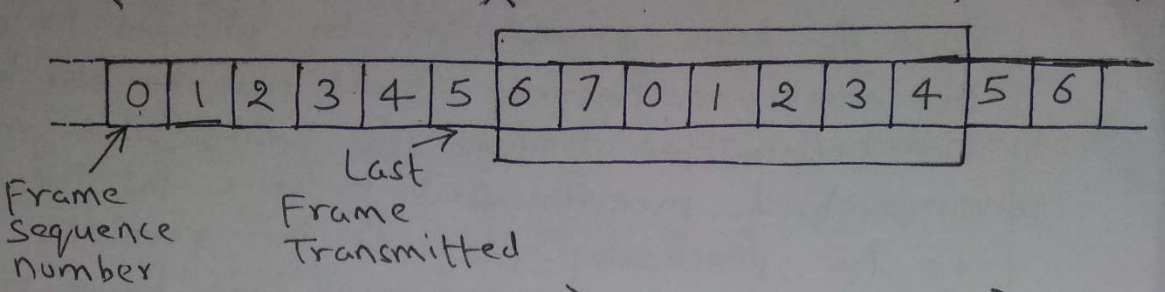
Q.No.1b.) In situations where transmitter can send faster than receiver can process it- explain how sliding window protocol used on ARQ provide flow control. (08)

Solution)

Automatic Repeat Request (ARQ) is a process for error control based on retransmissi of the corrupted data. when an error is detecte the receiver can have the specified frame retransmitted by the sender. In situations where transmitter can send faster than receiver can process the received packets may be discarded resulting in unreliable communication. In such cases flow control is required to pace the data transfer at an acceptable speed, by seting up a set of procedures that tells the sender how

much data it can transmit before it must wait for an acknowledgment from the receiver. The flow of data should not be allowed to overwhelm the receiver. Receiver should also be able to inform the transmitter before its limits (which may be amount of memory used to store the incoming data or the processing power at the receiving end) are reached and the sender must send fewer frames. ARQ protocols make provisions for retransmission.

Sliding window algorithms used by TCP, permit multiple, permit multiple data packets to be in simultanious transit, making more efficient use of network bandwidth. By using this protocol the sender station sends sequentially numbered frames to keep track of the frame. If the header of the frame allows k bits, the sequence numbers range from 0 to $2^k - 1$. Sender maintains a list of sequence numbers that it is allowed to send (sender window). The size of the senders window is at most $2^k - 1$. The sender is provided with a buffer equal to window size. Receiver also maintains a window of size $2^k - 1$. The receiver acknowledges a frame by sending an Ack frame that includes the sequence number of next frame expected. This also announces that it is prepared to receive the next N frames, begining with the number specified. This scheme can be used to acknowledge multiple frames. It could receive frames 2, 3, 4 but without acknowledge until frame 4 has arrived. By returning an Ack with sequence number 5, it acknowledges frams 2, 3, & 4 in one go. The receiver needs a buffer of size 1. Window announcements are used to inform the remote host of the current ~~size~~ window size.



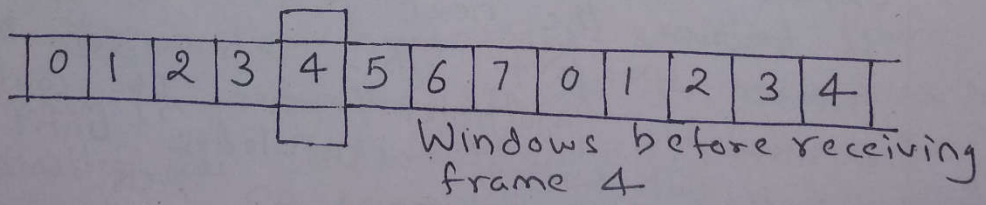
Window shrinks as frames are sent

Window expands as acknowledgements are received

Fig 3(a) Senders Window

Senders sliding window: At any instant, the sender is permitted to send frames with sequence numbers in a certain range (the sending window) as shown in fig 3(a)

Receiver sliding window: The receiver always maintain a window of size 1 as shown in figure 3(b). It looks for a specific frame (frame 4 in fig) to arrive in a specific order. If it receives any other frame it is discarded and it needs to be resent. The receiver window also slides by one as the specific frame is received and accepted. The receiver acknowledges a frame by sending an ACK that includes the sequence no. of next frame that is expected.



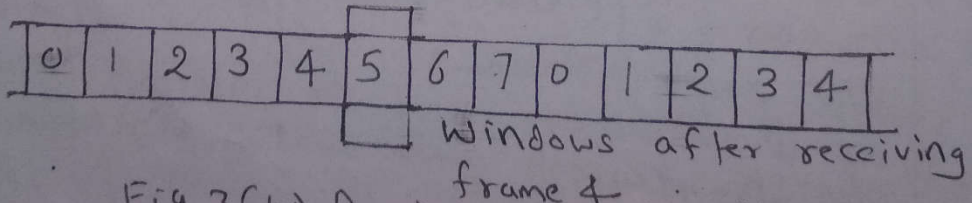


Fig 3(b) Receiver Sliding Window

P/95

Q.No. 2a.) Explain ATM cell format with necessary diagram. (04)

Solution) ATM uses fixed-size cells, consisting of a 5-octet header and a 48-octet information field. There are several advantages to the use of small, fixed-size cells. First, the use of small cells may reduce queuing delay for a high-priority cell, because it waits less if it arrives slightly behind a lower-priority cell that has gained access to a resource (e.g., the transmitter). Second, it appears that fixed-size cells can be switched more efficiently, which is important for the very high data rates of ATM. With fixed-size cells, it is easier to implement the switching mechanism in hardware. Header Format Figure 3.11a shows the header format at the user-network interface. Figure 2a (b) shows the cell header format internal to the network. Internal to the network, the Generic Flow Control field, which performs end-to-end functions, is not retained. Instead, the Virtual Path Identifier field is expanded from 8 to 12 bits. This allows support for an expanded number of VPCs internal to the network, to include those supporting subscribers and those required for network management.

The **Generic Flow Control** (GFC) field can be used for control of cell flow at the local user-network interface. The field could be used to assist the customer in controlling the flow of traffic for different qualities of service.

The **Virtual Path Identifier** (VPI) field constitutes a routing field for the network. It is 8 bits at the user-network interface and 12 bits at the network-network interface, allowing for more virtual paths to be supported within the network.

The **Virtual Channel Identifier** (VCI) field is used for routing to and from the end user.

The **Payload Type** (PT) field indicates the type of information in the information field. The PT field can provide in-band control information.

The **Cell Loss Priority** (CLP) field is used to provide guidance to the network in the event of congestion. A value of 0 indicates a cell of relatively higher priority, which should not be discarded unless no other alternative is available. A value of 1 indicates that this cell is subject to discard within the network. The **Header Error Control** (REC) field is an 8-bit error code that can be used to correct single-bit errors in the header and to detect double-bit errors.-(02)

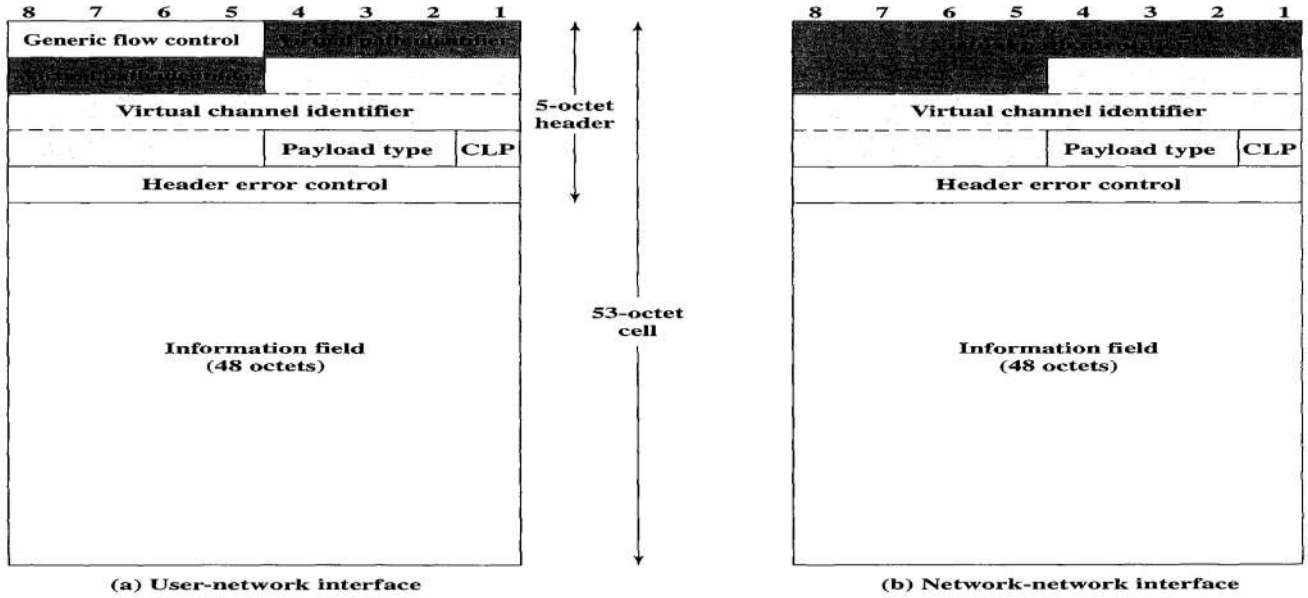


Figure: ATM Cell Format **--------(02)**

Q.No. 2b.) Differentiate between WANs and LANs. (04)

Solution) ------(01 for each point)

The key distinctions between LANs and WANs are as follows:

1. The scope of the LAN is small, typically a single building or a cluster of buildings. This difference in geographic scope leads to different technical solutions.
2. It is usually the case that the LAN is owned by the same organization that owns the attached devices. For WANs, this is less often the case, or at least a significant fraction of the network assets are not owned. This has two implications. First, care must be taken in the choice of LAN, since there may be a substantial capital investment (compared with dial-up or leased charges for WANs) for both purchase and maintenance. Second, the network management responsibility for a LAN falls solely on the user.
3. The internal data rates of LANs are typically much greater than those of WANs.

A simple example of a LAN that highlights some of its characteristics is shown in Figure below. All of the devices are attached to a shared transmission medium. A transmission from anyone device can be received by all other devices attached to the same network. Traditional LANs have provided data rates in a range from about 1 to 20 Mbps. High-speed LANs can provide data rates of 100 Mbps to 10 Gbps.

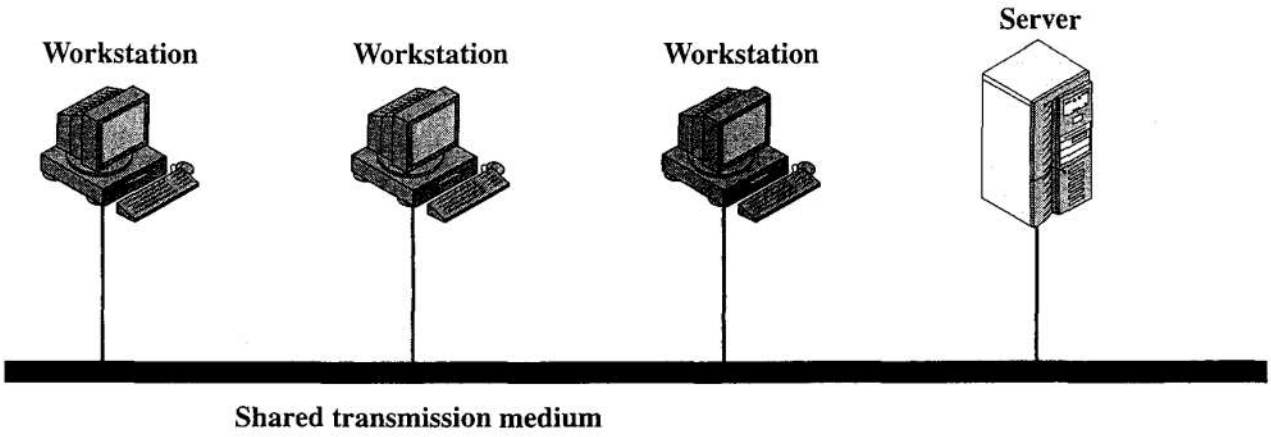


Figure: Local Area Network -----(01)

Q.No. 2c.) Write short note on IEEE 802.16 Protocol Architecture (04)

Solution)

Protocol Architecture: ---(02)

Protocols defined specifically for wireless transmission address issues relating to the transmission of blocks of data over the network. Figure below relates the four protocol layers defined in the 802.16 protocol architecture to the OSI model. Working from the bottom up, the lowest two layers of the 802.16 protocol model correspond to the physical layer of the OSI model and include such functions as

- Encoding/decoding of signals
- Preamble generation/removal (for synchronization)
- Bit transmission/reception

The 802.16 physical layer is concerned with medium-dependent issues, and the transmission layer is concerned with the bulleted items listed above.

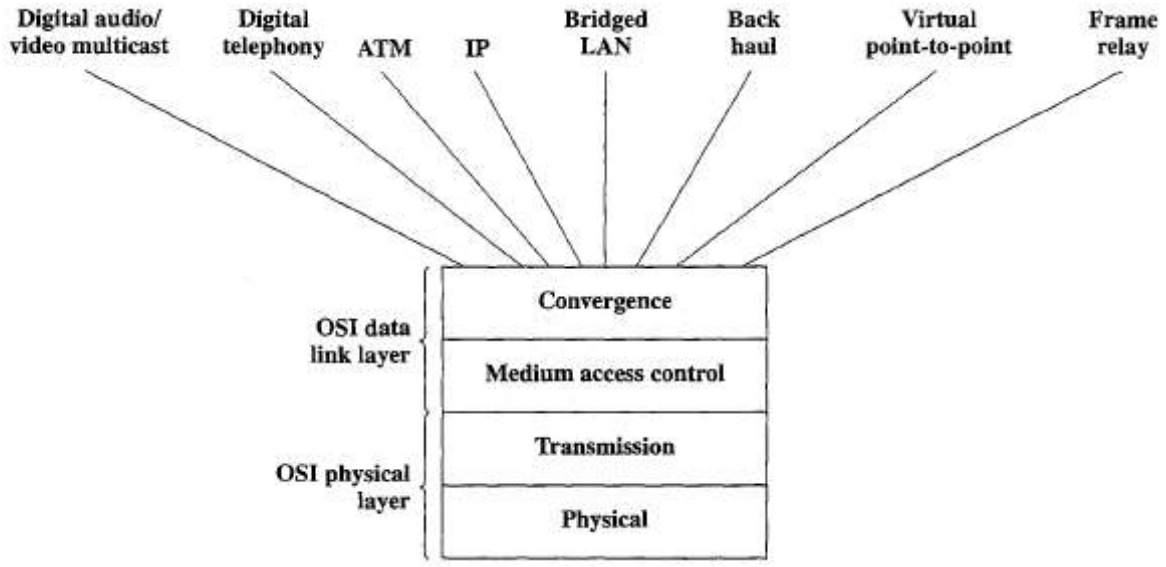


***Figure: IEEE 802.16 Protocol Architecture*--------(02)**

Above the physical and transmission layers are the functions associated with providing service to subscribers. These include

• On transmission, assemble data into a frame with address and error detection fields.
• On reception, disassemble frame, and perform address recognition and error detection.
• Govern access to the wireless transmission medium.

These functions are grouped into a medium access control (MAC) layer. The protocol at this layer, between the base station and the subscriber station, is responsible for sharing access to the radio channel. Specifically, the MAC protocol defines how and when a base station or subscriber station may initiate transmission on the channel.

Above the MAC layer is a convergence layer that provides functions specific to the service being provided. A convergence layer protocol may do the following:

• Encapsulate PDU (protocol data unit) framing of upper layers into the native 802.16 MACIPHY frames.
• Map an upper layer's addresses into 802.16 addresses.
• Translate upper layer QoS parameters into native 802.16 MAC format.
• Adapt the time dependencies of the upper layer traffic into the equivalent MAC service.

The figure shows the use of *TCP/IP* and an application layer above the 802.16 protocols.

Q.No. 2d.) Explain simple WLL configuration with neat figure. (04)
Solution)

Figure below illustrates a simple WLL configuration.

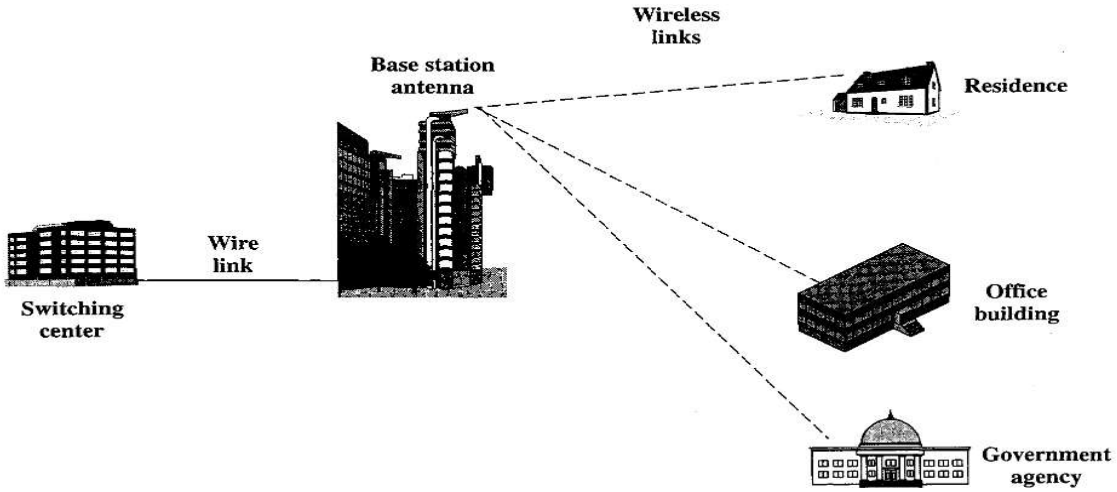


Figure: WLL Configuration **----------(02)**

A WLL provider services one or more cells. Each cell includes a base station antenna, mounted on top of a tall building or tower. Individual subscribers have a fixed antenna mounted on a building or pole that has an unobstructed line of sight to the base station antenna. From the base station, there is a link, which may either be wired or wireless, to a switching center. The switching center is typically a telephone company local office, which provides connections to the local and long-distance telephone networks. An Internet service provider (ISP) may be collocated at the switch or connected to the switch by a high-speed link.

The WLL has a number of advantages over a wired approach to subscriber loop support:-(01)

- **Cost:** Wireless systems are less expensive than wired systems.
- **Installation time:** WLL systems typically can be installed rapidly.
- **Selective installation:** Radio units are installed only for those subscribers who want the service at a given time. With a wired system, typically cable is laid out in anticipation of serving every subscriber in a local area.

WLL needs to be evaluated with respect to two alternatives: -------(01)

1.Wired scheme using existing installed cable: A large fraction of the earth's inhabitants do not have a telephone line. For high-speed applications, many subscribers with telephone lines do not have a line of sufficient quality or are too far from the central office to effectively use xDSL. Many of these same subscribers also do not have cable TV or their cable provider does not offer two-way data services. Finally, because WLL has become

cost-competitive with wired schemes, new installations face a genuine choice between the wired and wireless approaches.

• **Mobile cellular technology:** Current cellular systems are too expensive and do not provide sufficient facilities to act as a realistic alternative to WLL. A major advantage of WLL over mobile cellular is that, because the subscriber unit is fixed, the subscriber can use a directional antenna pointed at the base station antenna, providing improved signal quality in both directions.